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RESTORATION OF PHYSICAL PERFORMANCE CAPACITY OF
ATHLETES AFTER PROLONGED RESTRICTION OF THEIR
MOTOR ACTIVITY

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and V. I. Finogeyev

Translation of "Vosstanovleniye fizicheskoy raboto-
sposobnosti sportsmenov posle dlitel'nogo ogranicheniya
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16. Abstract <p>The effects of different regimens of treatment following prolonged hypokinesia were studied in order to determine the most effective program. The types of programs considered were passive means, consisting of physical therapy; active means, consisting of athletic training; and a combined program.</p> <p>In the first stage of the experiment, the effects of a 10 day period of hypokinesia were studied. It was determined that the restoration programs must address the problems of 1) increasing defense function and general tone of the body, 2) restore orthostatic stability, 3) increase general endurance.</p> <p>In later stages, groups of athletes and non-athletes underwent 30 day periods of hypokinesia. Restoration was carefully monitored for groups treated with the various regimens. It was determined that the most effective treatment was a comprehensive program of passive and active therapy.</p>			
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RESTORATION OF PHYSICAL PERFORMANCE CAPACITY OF
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The reduction in the percentage of physical labor that is linked to scientific and technical progress results in a decrease in human motor activity, as a result of which a deficit of muscle activity is observed. At the same time, the automation of production, reducing the expenditures of muscle strength require of man rapid reactions, orientation, dexterity in his movements, which is possible only with a high level of development of all the physical qualities. In addition, a whole series of modern occupations are unthinkable without excellent human physical training.

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Modern science is closely engaged in studying the consequences of restricted motor activity, as well as in working out measures for counteracting the negative influence of hypokinesia on the human health and performance capacity. By now, numerous studies have been made on the given question, which demonstrate, that during hypokinesia the functional potentialities of the organism decline, negatively affecting human health and performance capacity (A. V. Korobkov, 1959-1968; L. I. Kakurin, 1965-1971; L. A. Ioffe, 1966-1977; B. S. Katkovskiy, 1965-1971; M. I. Cherepakhin, 1968-1971; V. V. Bazhanov, 1964-1972; Yu. M. Stoyda, 1967-1974; L. V. Chkhandze, 1968-1969; O. G. Gazenko, 1970; A. R. Katovskaya, 1970-1971; N. Ye. Panferova, 1966-1977; V. S. Georgiyevskiy, 1966-1974; and others). A large number of studies have established that the wise use of physical exercises normalizes the functional state of the human organism and

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**Numbers in margin indicate pagination in original foreign text.

promotes its more optimal activity (N. A. Dmitriyev, 1961; Yu. K. Dem'yanenko, 1962; B. K. Zamarenov, 1960-1968; Yu. A. Sandalov, 1967-1971, and others). The very process of restoration of the performance capacity of athletes after clinical recovery has been studied fairly completely.

At the same time there is no coverage in the scientific literature of the nature of training of athletes in the rehabilitation period after a hypokinetic regimen, which is necessary to guarantee the optimal restoration of the physical performance capacity. /20

Prolonged interruptions in athletic studies for different reasons are fairly frequent, even in athletes of the highest qualification. The need to set up a scientifically substantiated and experimentally verified program (group of methods) for restoration of physical performance capacity of athletes after prolonged hypokinesia is obvious to us.

In principle, there are three possible approaches to compilation of such a complex target program:

1. The use of sets of exercises (so-called passive means), that are based on means of therapeutic physical culture, physical therapy and balneological methods.
2. The use of sets of exercises (so-called active means) that are identical to the athletic training.
3. Comprehensive use of active and passive means.

In our opinion, the hypothetically formulated program for restoration of the physical performance capacity of athletes after hypodynamia must include the comprehensive use of active and passive means with the leading role of comprehensive physical training. Such an approach suggests the separation of the restoration period into three stages.

First stage--training of the athlete's body for the reception of the next increase in loads with primary directivity of the physical exercises towards restoration of the orthostatic stability.

Second stage--increase in the functional potentialities of the body by increasing the volume of the loads, which must have a favorable effect on the physical performance capacity of the athletes.

Third stage--stabilization of the volume and increase in the intensity of the loads, as a result promoting the complete restoration of the physical performance capacity.

With regard for the aforementioned, in 1970-1974 we conducted research whose goal was to experimentally substantiate a complex program for the restoration of the physical performance capacity of athletes after prolonged restricted motor activity.

The first stage of the research (first experiment) was directed towards an investigation of the effect of 10-day hypokinesia on the physical performance capacity and functional condition of the athlete's body. A study was also made of the restoration of physical performance capacity and the functional condition of the subjects in the immediate (14 days) rehabilitation period (RP) with the use of physical exercises from the types of athletics selected by the athletes.

The subjects were 10 athletes of relatively the same age, but with different anthropometric indices and level of performance capacity. The heterogeneity in the group is explained by the strictness of the medical selection.

In the experimental period, the subjects were exposed to different medical and biological studies in order to clarify the effect on the condition of their bodies of pharmacological preparations.

The indices of physical performance capacity of the athletes and their functional condition were measured before hypokinesia and after it, on the 2nd, 7th and 14th days.

After hypokinesia, in all the subjects a considerable drop in body weight was observed (degree of decline was expressed individually), for which the main cause was the negative balance of water-salt metabolism.

After hypokinesia the performance capacity was evaluated from the indices

of the functional test with the maximum physical load. Here, in 50% of the cases, a drop in performance capacity was observed, in 40%--an increase, and in 10%--it remained on the previous level.

The increase in performance capacity after hypokinesia apparently occurred, first, as a result of the considerable drop in body weight; second, due to the fact that in the individuals who had the hardest time enduring the restricted mobility (specialization--gymnastics) a positive emotional condition appeared when the bedrest regimen was replaced.

Consequently, the changes in physical performance capacity of the subjects have a varied nature.

On the seventh day at the end of the hypokinetic regimen, the physical performance capacity of the subjects during the fulfillment of the maximum physical load (MPL) dropped on the average by 14%. A sharper decline in the performance capacity was noted in the individuals, in whom its increase was observed in the first examination. A decline in the total performance capacity in kg-m/min., probably, can be explained by two reasons: the consequences of hypokinesia (the process of rehabilitation has not ended), and the training loads of the first days of the restoration period. As for the drop in the performance capacity in kg-m/min per kg of weight, it apparently occurred as a result of the increase in weight of the subjects.

On the 14th day at the end of the hypokinetic pattern the total physical performance capacity in kg-m/min reached the original level, and only in three of the subjects was incomplete restoration observed. The performance capacity in kg-m/min per kg of body weight in relation to the original level in the majority of subjects declined.

Thus, changes in the physical performance capacity of the subjects during the 14 days of restoration at the end of hypokinesia have a wavy nature. Every other day there was an increase in performance capacity, then drop, and again rise.

During the measurement of performance capacity with MPL on the velo-ergometer, the dynamics of changes in physiological functions was recorded. The

obtained indices do not coincide with the changes in performance capacity of the subjects and have an individual nature. /21

It should be noted that the indices for the physiological functions of the subjects at rest change far from in parallel to the changes in performance capacity and have the most varied nature, which makes it possible to speak of the clearly pronounced individual adaptation to the conditions of hypokinesia.

The process of adaptation during the transition from hypokinesia to active athletic activity also occurred individually in the subjects.

Apparently, in order to judge the nature and quality of changes in performance capacity and functional condition of the bodies of the subjects during hypokinesia and after it, it was necessary to make a thorough study of the individual features of the process of adaptation before the experiment and at its end. One can assert that only a measurement of performance capacity itself gives comparatively complete information about the process and the nature of restoration of physical performance capacity of an athlete.

It should be noted, that 10-day hypokinesia is accompanied by a considerable decline in the muscle tone, strength of the main muscle groups, impairment in the functioning of the vestibular apparatus and the orthostatic stability, rise in the peripheral resistance of the vessels, drop in the per-minute and systolic discharges of blood, exacerbation in the general effectiveness of renal blood flow, and decrease in the volume of circulating plasma.

All of these changes had a great effect on the physical performance capacity of the athletes: even in 1.5 months at the end of the hypokinetic regimen in all the subjects without exception it still was not restored for many indices of motor function.

The experiment demonstrated that in planning the restoration measures it is necessary in the first place to solve the following tasks:

--increase the defense function of the organism and its general tone;

--restore orthostatic stability, for which one has to activate the nerve-

muscle pulsing of the posture musculature, coordination of the posture musculature muscles, and strength of the muscles in their interrelationship;

--increase the general endurance, for which one needs to strengthen the cardiac muscle, circulatory function, to increase the tone of the respiratory musculature and strength of the respiratory muscles.

The findings made it possible to experimentally verify the complex target program we developed.

At the second stage of the study 27 subjects participated who varied in age from 20-36: 21 people participated in the experiment with 30-day effect of hypokinesia with varying orth- and antiorthostatic angles. Six subjects who comprised the control group had a free movement regimen under clinical conditions. The deficit of their motor activity was compensated for by physical exercises taken from the first regimen of the complex target program.

The third stage of study, in which there were 21 participants represented the pedagogical experiment conducted to compare the effectiveness of the two patterns worked out by us on the basis of published data, personal experience and the first stage of study in the complex target program for control of the process of restoration of physical performance capacity in the immediate (15 days) period after 30-day hypokinesia (first pattern--for subjects of the I group, second--for subjects of the II group).

The first pattern consisted of means of general and special physical training, and the second--means of therapeutic physical culture, physical therapy and balneological procedures, and massage.

A study of the patterns and comparison of the effectiveness of their use were carried out by comparing the functional indices and physical performance capacity of the subjects in the experimental and control groups in the background period and in the period of restoration, on the 2nd, 8th and 15th days.

At the third stage of study, there were 21 participants and they were divided into three groups:

--the first experimental group included 9 people (first pattern) who underwent the effect of 30-day hypokinesia, with ortho- and antiorthostatic positions (angles +6, -2, -6°);

--the second experimental group (second pattern) also had 9 participants who underwent the same effect of hypokinesia as the first group.

--the control group consisted of 3 people who underwent the effects identical to the first and second groups in a parallel experiment. They did not use physical exercises in the restoration period.

The degree of physical preparedness of the selected subjects was different. They included 22 athletes of varying specialization (10 in the 10-day experiment and 12 in the 30-day) and 15 untrained individuals (engineers, physicians and scientific colleagues).

In the experiments with 10-day strict bedrest regimen there were 10 participants, and 21 in the 30-day. A total of 35 people were examined.

We made 424 examinations--before each experiment, in the so-called background period (BP)--from 40-72 examinations.

The results obtained after conducting the pedagogical experiment definitively convinced us of the correctness of the selected path.

Within 24 hours of the end of hypokinesia the performance capacity in all groups had dropped: in the first and second experimental groups roughly by 20%, in the control--by 60%.

On the ninth day a certain degree of restoration of the performance capacity was noted that significantly differed in various groups. Thus, in the first group it reached the level roughly equal to 90% of the original, in the second--85%, /22 in the control--86%.

On the 15th day, in the first group, the performance capacity was roughly equal to 93%, in the second--90%, and in the control--85%, i.e., in the experimental groups a subsequent process of restoration of performance capacity was

observed that occurred considerably more slowly than in the first 9 days.

Thus, on the 15th day no complete restoration of the performance capacity was observed in any of the groups, which indicates the very deep effect of the hypokinetic regimen on the subjects.

In all the groups as a result of hypokinesia the strength of the muscle-extensors and (to a lesser degree) flexors was weakened. In the 15 days of restoration in both groups the total indices for strength of the flexor muscles and the extensor muscles were almost equal to the original amounts. Here the differences in the strength indices on the 15-day of the restoration were not reliable between the first and second groups. In the first 9 days, in both groups, the strength of the aforementioned muscles was restored faster than in the second half of the restoration period. In the first group, the indices were higher than in the second.

In both groups, there was a sharp drop in the strength of the extensor muscles in the torso. This group of muscles was restored more slowly and their size did not reach the original data.

On the average, the greatest increase in strength of all the muscle groups was observed in the first experimental group.

Consequently, the complex target program of the first pattern had a great stimulating effect on the restoration of muscle strength.

In almost all the special exercises after hypokinesia a decline in the results was observed. Since the examined exercises are directed towards the development of strength endurance, this fact indicates that the given physical quality is noticeably lost in the hypokinetic process.

On the average in the first group, the process of restoration of the strength endurance occurs more intensively than in the second. The same is observed also in the restoration of other qualities. In the control group, the strength endurance was practically not restored in 15 days.

The hypokinetic pattern had a suppressing effect also on the static endurance

(the subjects maintained a pos. for 40 s).

After the hypokinesia, the cardiac contraction rate at rest, after a load and at the end of the fifth minute of restoration was increased from 12 to 21 bt/min. On the ninth day of restoration, this pattern in both groups was pronounced even more strongly. In the first group, the CCR was somewhat lower, while the restoration occurred faster than in the second.

On the 15th day, the indices of only the subjects in the first group reached the original amounts.

Thus, one can assert, that the first pattern of the complex target program for control of the process of restoration of physical performance capacity, consisting of means of general and special physical training, physical therapeutic procedures, as well as self- and mutual massage in the rehabilitation period had a better effect on the bodies of the subjects, than the means and methods of the second pattern (therapeutic physical culture, physical therapy and balneological procedure, massage). At the same time, a comparison of the results from the complex program consisting of two patterns with the final indices of the control group, where the restoration of physical performance capacity occurred without the use of physical exercises, explicitly speaks in favor of the complex program.

The purposeful effects in the restoration period after 30-day restricted motor activity permitted a more rapid elimination of the consequences of the hypokinetic syndrome, than in analogous experiments without the use of special means of restoring the physical performance capacity.

Depending on the specific conditions for hypokinesia, the first (active) or second (passive) patterns of complex target program can be recommended.

Here it is necessary to take into consideration that the active pattern should be used for forced restoration of the physical performance capacity of athletes (with regard for their specialization and degree of physical preparedness) after their clinical recovery; it is recommended that the passive regimen be used for restoration of physical performance capacity of athletes in the

period of clinical recovery.

For the greatest effectiveness of different programs to restore performance capacity that have been developed by analogy with that we have presented, it is recommended that means of general and special preparation be used in combination with physical therapy and balneological methods.

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